QUALITY ASSURANCE PROVISIONS (QAP)

(PRODUCT ASSURANCE PAM 702-155)

1. COMMAND AGENCY: **U. S. ARMY TANK AUTOMOTIVE RESEARCH, DEVELOPMENT & ENGINEERING CENTER, WARREN, MI 48397-5000**

2. THESE QAPS FORM PART OF DRAWING / SPECIFICATION **10898041 TAB** AS SPECIFIED IN THE CONTRACT. INSPECTION SHALL BE CONDUCTED AS SPECIFIED HEREIN AND IN ACCORDANCE WITH REFERENCED DOCUMENTS. THIS INCLUDES GENERAL QUALITY ASSURANCE PROVISIONS (STA FORM 458), WHICH FORMS A PART OF THIS QAP.

3.

PART I - LIST OF APPLICABLE DOCUMENTS

DRAWINGS

8689041	MATERIAL SPECIFICATION
10879884	GO COMPOSITE PLUG GAGE
10879885	NO GO PADDLE PLUG GAGE
10879886	SPLINED ARBOR
10879887	SET MASTER
10879888	GO SNAP GAGE, NO GO SNAP GAGE
10879890	MASTER GEAR
10879893	POT TYPE ARBOR
10879894	O. E. RADIUS GAGE
10881469	D. E. SNAP GAGE
10898040	GEAR SHAFT, SPUR, FINAL DRIVE (MATING GEAR)
10925486	SHAFT, FINAL DRIVE (MATING GEAR)
10936276	SHAFT, FINAL DRIVE (MATING GEAR)

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REVISIONS

4. RELEASE NUMBER	BRI - U4355														
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SHEETS	7. SHEET														

8. QAP FOR: **GEAR, SPUR, FINAL DRIVE** **M992A2/M109/A1/A1B/A2/A3/A3B**			9. CODE **19207**	
10. SUBMITTED BY: **BARNES & REINECKE, INC.**			11. QAP NO. **10898041**	
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STA FORM 456 1 FEB 83 PREVIOUS EDITIONS ARE OBSOLETE BRI-G015-001, DEC.97

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PART I - LIST OF APPLICABLE DOCUMENTS (CONTINUED)

STANDARDS

MIL-STD-130	IDENTIFICATION MARKING OF U.S. MILITARY PROPERTY
SAE J442	TEST STRIP, HOLDER AND GAGE FOR SHOT PEENING
SAE J443	PROCEDURES FOR USING SHOT PEENING
ASTM E1444	STANDARD PRACTICE FOR MAGNETIC PARTICLE EXAMINATION
SAE ASM 2418	COPPER PLATING (ELECTRODEPOSITED)
SAE-AMS-S-13165	SHOT PEENING OF METAL PARTS

SPECIFICATIONS

DOD-P-16232	PHOSPHATE COATING, HEAVY MANGANESE OR ZINC BASE FOR METALS
MIL-S-46172	STEEL FORGINGS

PART II - INSPECTION REQUIREMENTS

TABLE I - CLASSIFICATION OF QUALITY CONFORMANCE CHARACTERISTICS

CLASS	CHARACTERISTIC	ZONE	INSPECTION METHOD
CRITICAL	NONE		
MAJOR	AQL 1.0% DEFECTIVE		
101	INVOLUTE SPUR GEAR, EXTERNAL, 61 TEETH, 25° PRESSURE ANGLE, 4 DIAMETRAL PITCH	E4	GAGE 10879890 AND IMC PAGE 9
102	"A" DIAMETER	D4	DIAL SNAP GAGE
103	4.333 - .005 DIAMETER	C3	GAGE 10881469
104	15.530 - .010 DIAMETER	C2	GAGE 10879888
105	15.8363 -.0070 DIAMETER OVER TWO .480 DIAMETER PINS	C7	DIAL SNAP GAGE, AND GAGE 10879887
106	PITCH DIAMETER OF GEAR TO BE CONCENTRIC WITH "A" DIAMETER (*) WITHIN .003 TIR, AND PERPENDICULAR TO "X" MARKED SURFACES WITHIN .002 TIR (NOTE 4)	B8	GAGE 10879893, BENCH CENTERS, .4800 DIAMETER PIN, DIAL INDICATOR WITH STAND

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PART II - INSPECTION REQUIREMENTS

TABLE I - CLASSIFICATION OF QUALITY CONFORMANCE CHARACTERISTICS (CONTINUED)

CLASS	CHARACTERISTIC	ZONE	INSPECTION METHOD
MAJOR			
107	INTERNAL INVOLUTE SPLINE, FLAT ROOT, 26 TEETH, 30° PRESSURE ANGLE, 8/16 DIAMETRAL PITCH	E6	GAGES 10879884, 10879886 IMC PAGE 10
108	SPLINE MINOR DIAMETER 3.1460 + .0035	E6	GO PLUG GAGE/NO PLUG GAGE AND IMC PAGE 10
109	PITCH SPLINE TO BE CONCENTRIC WITH "A" DIAMETER (*) WITHIN .005 TIR (NOTE 5)	A8	GAGE 10879886, BENCH CENTERS, DIAL INDICATOR WITH STAND
MINOR	**AQL 2.5% DEFECTIVE**		
201	1.440 DIMENSION	D2	DEPTH GAGE
202	2.500 DIMENSION	D3	WIDTH GAGE
203	.080 - .010 RADIUS	E3	GAGE 10879894
204	.080 RADIUS TO BE SMOOTH AND FREE OF TOOL AND GRIND MARKS	E2	VISUAL AND TACTILE
205	SURFACE TEXTURE "63" - 2 PLACES	C2/D3	COMPARATOR BLOCKS
206	SURFACE TEXTURE "125" (NOTE 8)	ALL	COMPARATOR BLOCKS
207	PART NUMBER, MANUFACTURING SERIAL NUMBER AND HEAT NUMBER APPLICATION (NOTE 2 AND DWG. 8689041, SHEET 2)	B4	VISUAL
208	WORKMANSHIP	ALL	VISUAL AND TACTILE

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PART II - INSPECTION REQUIREMENTS (CONTINUED)

TABLE II - 100% INSPECTION

1. MAGNETIC PARTICLE INSPECTION. AFTER SURFACE HARDENING, EACH FORGING SHALL BE SUBJECTED TO MAGNETIC PARTICLE INSPECTION OVER ITS ENTIRE AREA. FAILURE OF ANY FORGING TO MEET ACCEPTANCE STANDARDS SPECIFIED IN PART IV, PARAGRAPH 1 THROUGH 1.1, TEST METHODS AND PROCEDURES, SHALL BE CAUSE FOR REJECTION.

2. BACKLASH TEST. EACH GEAR, SPUR, FINAL DRIVE SHALL BE SUBJECTED TO A TEST WITH THE MATING PART (P/N 10898040) AT 9.375 CENTER DISTANCE TO ACHIEVE A BACKLASH OF .008-.014. SUCCESSFUL COMPLETION OF THE TEST IS REQUIRED BEFORE THE ITEM IS SUBMITTED TO THE GOVERNMENT FOR ACCEPTANCE.

3. ROLL TEST. EACH GEAR, SPUR, FINAL DRIVE SHALL BE SUBJECTED TO A ROLL TEST AS DESCRIBED IN PART IV, PARA. 2. SUCCESSFUL COMPLETION OF THE TEST IS REQUIRED BEFORE THE ITEM IS SUBMITTED TO THE GOVERNMENT FOR ACCEPTANCE.

TABLE III - SPECIAL SAMPLING INSPECTION

1. PREPRODUCTION INSPECTION. PRIOR TO INITIAL PRODUCTION APPROVAL, SAMPLE FORGING(S) THAT REPRESENT THE PRODUCTION PROCESSES TO BE USED FOR PRODUCTION FORGINGS SHALL BE SUBJECTED TO EXAMINATION AND TESTS BY THE CONTRACTOR. PREPRODUCTION APPROVAL INSPECTION SHALL INCLUDE VISUAL EXAMINATION, MEASUREMENT FOR DIMENSIONS AND TOLERANCES, CHEMICAL ANALYSIS AND NONDESTRUCTIVE TESTS FOR SOUNDNESS TO DETERMINE CONFORMANCE TO ALL REQUIREMENTS OF DRAWINGS 10898041, 8689041 AND MIL-S-46172. NONDESTRUCTIVE TESTS FOR SOUNDNESS SHALL BE BY MAGNETIC PARTICLE INSPECTION AS SPECIFIED IN PART IV, PARA. 1 THROUGH 1.1.

1.1 MANUFACTURING PROCESS CHANGE. WHENEVER A CHANGE IS MADE IN THE MANUFACTURING PROCEDURE USED IN PRODUCTION, WHICH MAY AFFECT FIT, FUNCTION, OR SERVICE LIFE OF THE ITEM, THE GOVERNMENT REPRESENTATIVE WILL BE NOTIFIED PRIOR TO THE CHANGE AND ONE OF THE FIRST FIRST ITEMS PRODUCED UNDER THE NEW PROCESS SHALL BE GIVEN A COMPLETE INSPECTION AS SPECIFIED IN PARAGRAPH 1.

1.2 FAILURE. FAILURE OF THE PREPRODUCTION SAMPLE TO MEET THE SPECIFIED REQUIREMENTS SHALL BE CAUSE FOR REJECTION. THE CONTRACTOR SHALL PROVIDE OBJECTIVE EVIDENCE TO THE GOVERNMENT WITHIN 20 DAYS AFTER FAILURE, OF EFFECTIVE CORRECTIVE ACTION TAKEN IN PREVENTING RECURRENCE OF FAILURES AND PARAGRAPH 1 SHALL APPLY UNTIL ACCEPTABLE ITEMS ARE PRODUCED.

2. INITIAL PRODUCTION INSPECTION. ONE (1) OF THE FIRST ITEMS PRODUCED SHALL BE SELECTED AT RANDOM AND SUBJECTED TO EXAMINATIONS AND TESTS BY THE CONTRACTOR. THE ITEM SHALL BE PRODUCED UNDER MANUFACTURING METHODS TO BE USED IN PRODUCTION. INITIAL PRODUCTION INSPECTION SHALL BE ACCOMPLISHED TO DETERMINE CONFORMANCE TO ALL REQUIREMENTS OF DRAWINGS 10898041, 8689041 AND SPECIFICATION MIL-S-46172.

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PART II - INSPECTION REQUIREMENTS (CONTINUED)

TABLE III - SPECIAL SAMPLING INSPECTION (CONTINUED)

2.1 MANUFACTURING PROCESS CHANGE. WHENEVER A CHANGE IS MADE IN THE MANUFACTURING PROCEDURE USED IN PRODUCTION, ONE (1) OF THE FIRST ITEMS PRODUCED UNDER THE NEW PROCESS SHALL BE GIVEN A COMPLETE INSPECTION AS SPECIFIED IN PARAGRAPH 2.

2.2 FAILURE. FAILURE OF THE ITEM TO MEET INITIAL PRODUCTION APPROVAL REQUIREMENTS SHALL BE CAUSE FOR REJECTION AND PARAGRAPH 2 SHALL APPLY UNTIL ACCEPTABLE ITEMS ARE PRODUCED.

3. PROCESS INSPECTION

3.1 HARDNESS PROCESS.

3.1.1 CONTINUOUS HEAT TREATMENT (WHEN APPLICABLE). WHERE CONTINUOUS HEAT TREATING DOES NOT EXCEED FIVE HUNDRED PARTS (500), THE FIRST PART, ONE OF THE PARTS FROM THE MIDPOINT OF THE RUN, AND THE LAST PART SHALL BE INSPECTED FOR THE CHARACTERISTICS LISTED (301, 302 AND 303).

3.1.1.1 FREQUENCY. WHERE CONTINUOUS HEAT TREATMENT EXCEEDS FIVE HUNDRED PARTS (500), THE FIRST PART, EACH TWO HUNDRED AND FIFTIETH (250) PART THEREAFTER, I.E. (250-500-750-ETC.) AND THE LAST PART OF THE RUN SHALL BE INSPECTED AS SPECIFIED ABOVE.

3.1.2 BATCH HEAT TREATMENT. A MINIMUM OF THREE (3) SAMPLE PARTS OR APPROVED CONTROL SPECIMENS OF THE SAME MATERIAL AND THICKNESS SHALL BE SELECTED FROM EACH HEAT TREATED BATCH OR LOT, FOR DETERMINATION OF EFFECTIVE CASE DEPTH, CORE HARDNESS AND SURFACE HARDNESS. SAMPLES OR SPECIMENS SHALL BE PROCESSED BY THE SAME HEAT TREATMENT PROCESS USED FOR PRODUCTION PARTS. INSPECTION AND HARDNESS TESTS SHALL BE PERFORMED TO DETERMINE CONFORMITY TO THE FOLLOWING CHARACTERISTICS:

NUMBER	CHARACTERISTIC	INSPECTION METHOD
301	EFFECTIVE CASE DEPTH TO BE RC 50 MINIMUM AT .060 DEPTH AND RC 50 MAXIMUM AT .080 DEPTH (DWG. 8689041, SHEET 2)	MICROHARDNESS TESTER AND IMC PAGE 11 (REF. PART IV, PARA. 3)
302	GEAR TOOTH SURFACE HARDNESS TO BE RC 57-62 (DWG. 8689041, SHEET 2)	HARDNESS TESTER AND IMC PAGE 11
303	SPLINE TEETH SURFACE HARDNESS TO BE RC 25 MINIMUM (DWG. 8689041, SHEET 2)	HARDNESS TESTER AND IMC PAGE 11

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PART II - INSPECTION REQUIREMENTS (CONTINUED)

TABLE III - SPECIAL SAMPLING INSPECTION (CONTINUED)

NUMBER	CHARACTERISTIC	INSPECTION METHOD
304	TOOTH CORE HARDNESS TO BE RC 25-45 (DWG. 8689041, SHEET 2)	HARDNESS TESTER AND IMC PAGE 11 (REF. PART IV, PARA. 3)
305	DECARBURIZATION AND CARBON CONCENTRATION OF CASE TO BE 0.70-0.90% (DWG. 8689041, SHEET 2)	MICROSCOPE EXAMINATION (REF. PART IV, PARA. 3)

3.1.3 **FAILURE**. FAILURE OF ANY ONE (1) TEST SAMPLE SHALL BE CAUSE FOR REJECTION OF THE ENTIRE REPRESENTATIVE PRODUCTION LOT. ITEMS PRODUCED SUBSEQUENT TO FAILURE OF A TEST SAMPLE SHALL NOT BE SUBMITTED FOR ACCEPTANCE UNTIL OBJECTIVE EVIDENCE HAS BEEN SUBMITTED TO THE GOVERNMENT THAT CORRECTIVE ACTION HAS ELIMINATED THE CAUSE OF THE FAILURE. ACCEPTANCE OF PRODUCTION LOTS SUBSEQUENT TO TEST FAILURE SHALL NOT RESUME UNTIL THREE (3) CONSECUTIVELY PRODUCED SAMPLES SUCCESSFULLY MEET THE SPECIFIED TEST REQUIREMENTS SPECIFIED IN PARAGRAPH 3.1.

3.2 **SHOT PEENING**

3.2.1 GEAR SPUR FINAL DRIVE SHALL BE SHOT PEENED IN ACCORDANCE WITH SAE-AMS-S-13165. THE SHOTS USED SHALL BE NUMBER CW28, CW32, CW35 OR CW41 FOR CUT WIRE SHOTS, AND NUMBER 280, 330 OR 390 CAST SHOTS.

3.2.1.1 A MINIMUM OF (1) ALMEN COUPON SHALL ACCOMPANY A LOT OF MATERIAL THROUGH THE ENTIRE PEENING OPERATIONS AND SHALL BE IDENTIFIED AS TO THE LOT THEY REPRESENT. THE ITEM SHALL BE SHOT PEENED WITH EACH GEAR, AND SHALL DETERMINE CONFORMITY TO THE FOLLOWING CHARACTERISTIC:

NUMBER	CHARACTERISTIC	INSPECTION METHOD
306	SHOT PEEN GEAR TEETH TO .018A2 INTENSITY AND 90% MINIMUM COVERAGE (DWG. 8689041, SHEET 2)	ALMEN GAGE PER SAE J442 AND RECOMMENDED PRACTICE SAE J443 AND VISUAL

3.2.2 **FAILURE**. FAILURE OF ANY ONE (1) TEST SAMPLE SHALL BE CAUSE FOR REJECTION OF THE ENTIRE REPRESENTATIVE PRODUCTION LOT. ITEMS PRODUCED SUBSEQUENT TO FAILURE OF A TEST SAMPLE SHALL NOT BE SUBMITTED FOR ACCEPTANCE UNTIL OBJECTIVE EVIDENCE HAS BEEN SUBMITTED TO THE GOVERNMENT THAT CORRECTIVE ACTION HAS ELIMINATED THE CAUSE OF THE FAILURE. ACCEPTANCE OF PRODUCTION LOTS SUBSEQUENT TO TEST FAILURE SHALL NOT RESUME UNTIL THREE (3) CONSECUTIVELY PRODUCED SAMPLES SUCCESSFULLY MEET THE SPECIFIED TEST REQUIREMENTS. SPECIFIED IN PARAGRAPH 3.2.

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PART III - CERTIFICATION REQUIREMENTS

NUMBER	CHARACTERISTIC	CERTIFICATION METHOD
401	MATERIAL (MIL-S-46172 OR DWG. 8689041) - CHEMICAL ANALYSIS - SOUNDNESS REQUIREMENTS - MECHANICAL PROPERTIES	CERTIFIED MATERIAL REPORT
402	HEAT TREATMENT (DWG. 8689041)	CERTIFIED PROCESS REPORT
403	SHOT PEENING (SAE-AMS-S-13165)	CERTIFIED PROCESS REPORT
404	COPPER PLATING (SAE AMS 2418)	CERTIFIED PROCESS REPORT
405	PHOSPHATE COATING (DOD-P-16232)	CERTIFIED PROCESS REPORT
406	CONTRACTOR'S MAGNETIC PARTICLE INSPECTOR(S)	CERTIFIED MAGNETIC INSPECTOR(S)
407	QUALIFIED METALLURGICAL INSPECTOR(S) (DWG. 8689041)	CERTIFIED METALLURGIST(S)
408	HYDROGEN EMBRITTLEMENT (AFTER SHOT PEENING) (DWG. 8689041)	CERTIFIED PROCESS REPORT

PART IV - TEST METHODS AND PROCEDURES

1. **MAGNETIC PARTICLE INSPECTION PROCEDURE**. THE CONTRACTOR SHALL PROVIDE A WRITTEN PROCEDURE FOR MAGNETIC PARTICLE INSPECTION OF PRODUCTION LOT. THE PROCEDURE SHALL BE SUBJECT TO GOVERNMENT APPROVAL PRIOR TO PRODUCTION LOT. THE PROCEDURE SHALL INCLUDE ESTABLISHMENT OF ACCEPTANCE STANDARDS THAT DETERMINE THE NATURE AND MAXIMUM SEVERITY OF DEFECTS THAT WILL BE ACCEPTED IN PRODUCTION PARTS.

1.1 **MAGNETIC PARTICLE INSPECTION**. AFTER FINAL HEAT TREATMENT IS COMPLETED, MAGNETIC PARTICLE INSPECTION SHALL BE CONDUCTED IN ACCORDANCE WITH ASTM E1444, UTILIZING A GOVERNMENT APPROVED PROCEDURE (METHOD TO BE USED IS OPTIONAL). SURFACE CRACKS, LAPS, OR SEAMS ARE UNACCEPTABLE. SURFACE DEFECTS MAY BE REMOVED WITHIN DIMENSIONAL LIMITS OF THE DRAWING.

QUALITY ASSURANCE PROVISIONS (QAP) (CONTINUATION SHEET)

(PRODUCT ASSURANCE PAM 702-155)

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PART IV - TEST METHODS AND PROCEDURES (CONTINUED)

2. ROLL TEST. INSTALLED ON A GLEASON ROLLING MACHINE OR EQUIVALENT, EACH GEAR SHALL BE ROLLED IN BOTH DIRECTIONS WITH A MATING MASTER GEAR, HAVING NOT MORE THAN .001 VARIATION FROM THE TRUE INVOLUTE, AND .001 TOTAL PARALLELISM ERROR. THE ROTATION SHALL BE ON NOMINAL CENTERS AND SHALL ACHIEVE A CONTACT PATTERN CONFORMING TO THE SKETCH IN DRAWING 10898041, ZONE A6.

3. HARDNESS INSPECTION. SAMPLE PARTS OR APPROVED CONTROL SPECIMENS SELECTED FOR INSPECTION AND TESTS SHALL HAVE THE SAME CHEMICAL COMPOSITION AS THE LOT OF MATERIAL THEY REPRESENT. THESE SAMPLES OR SPECIMENS SHALL ACCOMPANY THE LOT OF MATERIAL DURING THE ENTIRE HEAT TREATMENT PROCESS. TEST SAMPLES OR SPECIMENS SHALL BE SECTIONED, POLISHED AND ETCHED FOR EXAMINATIONS AND TESTS IN AREAS SHOWN ON IMC PAGE 11. CASE SHALL BE FREE FROM TOTAL DECARBURIZATION, GRAIN BOUNDRY CARBIDE NETWORK AND FREE FROM MASSIVE CARBIDES. FINE SCATTERED CARBIDES (AT 500X) ARE PERMISSIBLE.

QUALITY ASSURANCE PROVISIONS (QAP) -- INSPECTION METHOD CONTROL

(PRODUCT ASSURANCE PAM 702-165)

INSTRUCTIONS: USE SYMBOLS IN ACCORDANCE WITH ANSI Y14.5 — USE EXPANDING
LEGEND: MANDATORY REQUIREMENT — = LOCATIN — = MEASURING POINT — = DEVICES

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GEAR INSPECTION METHODS

(X) SPUR (-) HELICAL (X) EXTERNAL (-) INTERNAL

COMPOSITE METHOD OF INSPECTION WITH MASTER

COMPOSITE METHOD OF INSPECTION REQUIRES ROLLING PART GEARS IN TIGHT MESH WITH A MASTER GEAR ON A VARIABLE CENTER DISTANCE FIXTURE OR GEAR ROLLING MACHINE EQUIPPED WITH INDICATING DEVICE OR RECORDER.

(-) WHEN DEFINED ON DRAWING:
WHEN COMPOSITE TOLERANCES ARE DEFINED ON DRAWING, THE VALUES WILL BE THE MANDATORY CRITERIA FOR ACCEPTANCE OR REJECTION OF PART GEARS.
(-) TOOTH TO TOOTH COMPOSITE TOLERANCE _____
(-) TOTAL COMPOSITE TOLERANCE _____

(-) WHEN NOT DEFINED ON DRAWING:
(X) METHOD A:
ESTABLISH TOTAL COMPOSITE TOLERANCE BY ROLLING TEN ANALYTICALLY INSPECTED AND ACCEPTED PART GEARS WITH A MASTER GEAR
(-) METHOD B:
CALCULATE TOTAL COMPOSITE TOLERANCE USING 60% OF SUM TOTAL OF PROFILE, PITCH, AND RUNOUT TOLERANCES.
MATERIAL CONDITIONS
(-) TOTAL COMPOSITE TOLERANCE _____

NOTES:

IN ADDITION TO COMPOSITE INSPECTION, METHOD A OR B, ONE GEAR FROM EACH LOT SHALL BE ANALYTICALLY INSPECTED.
WHEN PART GEARS EXCEED THE LIMITS ESTABLISHED BY METHOD A OR B, ACCEPTANCE SHALL BE PREDICATED ON ANALYTICAL INSPECTION. PART GEARS ACCEPTED BY ANALYTICAL INSPECTION MAY BE USED TO RE-ESTABLISH LIMITS OF METHOD A OR B.

ANALYTICAL INSPECTION

(X) PROFILE TOLERANCE, + .001/- .001
(X) ZERO AT 15.250 DIAMETER
(X) PITCH TOLERANCE (TOOTH TO TOOTH) .0008
(-) INDEX TOLERANCE (ANY TWO TEETH) _____
(X) RUNOUT, PITCH DIAMETER TO MOUNTING AXIS .003
(-) LEAD TOLERANCE ACROSS FACE WIDTH _____
(X) TOOTH CROWN PER INCH OF FACE .001
(X) ARC TOOTH THICKNESS .3086 - .0034
(X) MEASUREMENT (X) OVER (-) BETWEEN
(-) ONE (X) TWO .4800 DIAMETER
(X) WIRES (-) BALLS 15.8363 - .0070

LEGEND: (X) APPLICABLE (-) NOT APPLICABLE

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QUALITY ASSURANCE PROVISIONS (QAP) -- INSPECTION METHOD CONTROL

(PRODUCT ASSURANCE PAM 702-165)

INSTRUCTIONS: USE SYMBOLS IN ACCORDANCE WITH ANSI Y14.5 — USE EXPANDING

LEGEND: MANDATORY REQUIREMENT — = LOCAT — = MEASURING POINT — = DEVICES

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SPLINE INSPECTION METHODS

TOOTH FORM:	(X) INVOLUTE	(-) STRAIGHT	(-) PARALLEL
TYPE OF FIT:	(X) SIDE	(-) MAJOR DIA	(-) MINOR DIA
ROOT TYPE:	(X) FLAT ROOT	(-) FULL FILLET ROOT	

INSPECTION WITH GAGES

(-) CIRCULAR TOOTH THICKNESS (EXTERNAL):
- (-) MAXIMUM EFFECTIVE _____
- (-) MINIMUM EFFECTIVE (-) REF _____
- (-) MAXIMUM ACTUAL (-) REF _____
- (-) MINIMUM ACTUAL _____

(X) CIRCULAR SPACE WIDTH (INTERNAL):
- (-) MINIMUM EFFECTIVE _____
- (X) MAXIMUM EFFECTIVE (X) REF .1978
- (X) MINIMUM ACTUAL (X) REF .1985
- (X) MAXIMUM ACTUAL .2000

(-) MAJOR DIAMETER FIT:
- (-) THE MAJOR DIAMETER AND EFFECTIVE SPLINE MUST BE CONCENTRIC AT MAXIMUM MATERIAL CONDITIONS

(-) MINOR DIAMETER FIT:
- (-) THE MINOR DIAMETER AND EFFECTIVE SPLINE MUST BE CONCENTRIC AT MAXIMUM MATERIAL CONDITIONS

ANALYTICAL INSPECTION NOTES

1. THE MAJOR AND MINOR DIAMETER INSPECTION METHODS ARE SPECIFIED ON PAGE/S 3 CHARACTERISTIC NUMBERS 107 - 108
2. FOR ROUTINE INSPECTION WITH GAGES, THE FOLLOWING SPLINE DATA MARKED (*) SHALL SERVE AS REFERENCE. THIS DATA HOWEVER MAY BE USED TO EVALUATE PARTS REJECTED BY GAGES OR MAY BE USED AS ACCEPTANCE CRITERIA FOR PROTOTYPE PARTS OR FOR SHORT RUNS WHERE SPLINE GAGES ARE NOT USED.
3. WHEN MARKED (X), ANALYTICAL INSPECTION IS REQUIRED AS A SUPPLEMENT TO INSPECTION WITH GAGES WHERE EACH INDIVIDUAL VARIATION MUST BE CONTROLLED.
   - (*) PROFILE TOLERANCE
     - (X) ZERO AT 3.250 PITCH DIAMETER +.0005/-.0007
     - (X) FORM DIAMETER (-) MAX (X) MIN (-) 3.352
   - (*) TOTAL INDEX TOLERANCE .0019
   - (*) LEAD TOLERANCE ACROSS _____ LENGTH OF ENGAGEMENT _____
   - (X) MEASUREMENT (-) OVER (X) BETWEEN TWO .1800 DIAMETER PINS 3.0563/3.0537

LEGEND: (X) APPLICABLE (-) NOT APPLICABLE (*) SEE NOTES 2 AND 3

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QUALITY ASSURANCE PROVISIONS (QAP) -- INSPECTION METHOD CONTROL

(PRODUCT ASSURANCE PAM 702-165)

INSTRUCTIONS: USE SYMBOLS IN ACCORDANCE WITH ANSI Y14.5 — USE EXPANDING

LEGEND: MANDATORY REQUIREMENT — 6" = LOCAT — ⓜ = MEASURING POINT — ❾ = DEVICES

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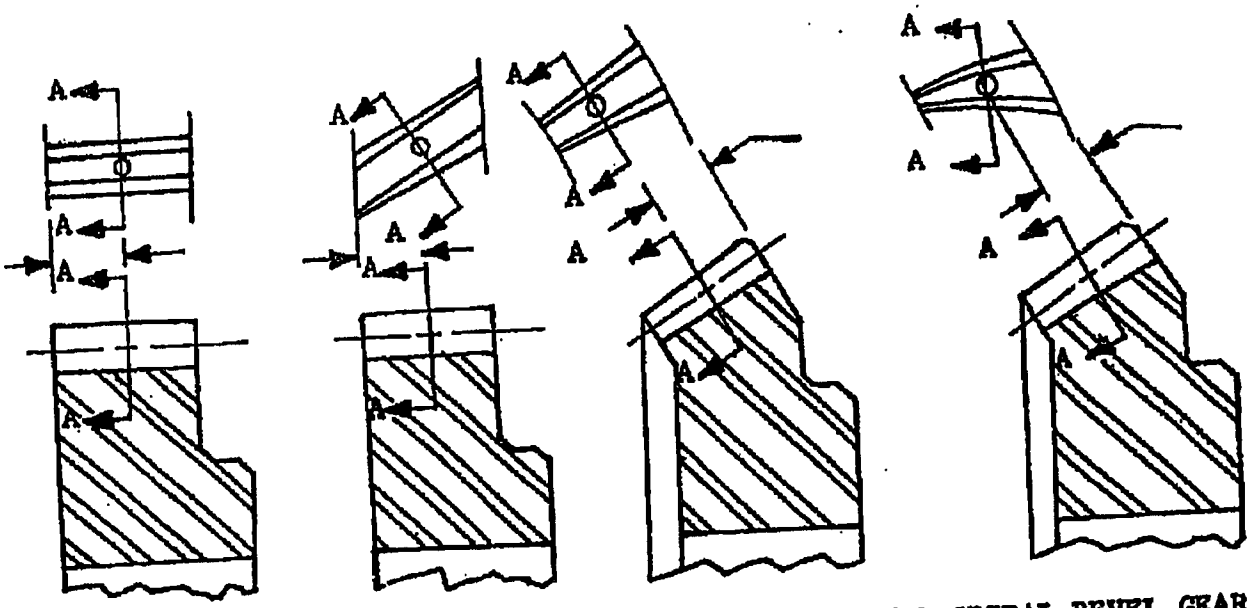
HARDNESS DETERMINATION METHODS



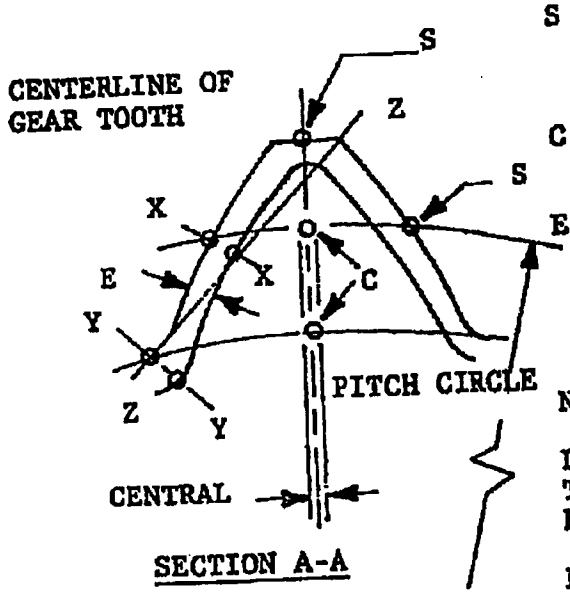
(X) SPUR GEAR

(-) HELICAL GEAR CUT NORMAL TO HELIX ANGLE

(-) STRAIGHT BEVEL GEAR

(-) SPIRAL BEVEL GEAR CUT NORMAL TO SPIRAL ANGLE

(-) HYPOID GEAR CUT NORMAL TO SPIRAL ANGLE



SECTION A-A

S = SURFACE HARDNESS RC 57-62
- (X) TOP LAND OF TOOTH
- (X) NORMAL TO TOOTH SURFACE AT PITCH CIRCLE

C = CORE HARDNESS RC 25-45
- (X) AT PITCH CIRCLE
- (-) AT ROOT CIRCLE

E = EFFECTIVE CASE DEPTH .060 - .080
CASE HARDNESS RC 50 MIN. AT .060; RC 50 MAX. AT .080
- (X) TRAVERSE ALONG LINE X-X NORMAL TO TOOTH SURFACE
- (-) TRAVERSE ALONG LINE Y-Y PERPENDICULAR TO LINE Z-Z

NOTES:

1. EFFECTIVE CASE DEPTH IS THE LENGTH OF LINE X-X OR LINE Y-Y MEASURED FROM THE SURFACE TO THE LAST POINT TOWARD THE CORE HAVING THE REQUIRED MINIMUM HARDNESS OF ROCKWELL C ___
2. LINE Z-Z IS TANGENT TO ROOT FILLET AND PASSING THROUGH OPPOSITE TIP CORNER.

LEGEND: (X) APPLICABLE (-) NOT APPLICABLE

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